WHAT IS CLAIMED IS:

1. A nanoreactor, comprising:

a nanoreactor shell having a thickness of at least 0.5 nm,

said nanoreactor shell enveloping an space, wherein,

said nanoreactor shell is not perfectly single crystalline, further comprising

a nanoparticle disposed within the space.

2. The nanoreactor as claimed in claim 1, wherein:

the shell thickness is between about .5 nm and 100 nm.

3. The nanoreactor as claimed in claim 2, wherein:

the shell thickness is between about 2 nm and 80 nm.

4. The nanoreactor as claimed in claim 3, wherein:

the shell thickness is between about 3 nm and 10 nm.

5. The nanoreactor as claimed in claim 1, wherein:

the shell comprises a material selected from the group consisting of

Pt, ZnS, ZnSe, ZnTe, ZnO, CoO, Co_3O_4 , Fe_2O_3, FeP, Fe_3O_4, FeO, TiO_2,

CdS, CdSe, CdTe, HgS, HgSe, HgTe, MgTe, GaN, GaP, GaAs, GaSb, InN,

InP, InAs, InSb, AlAs, AlP, AlSb, AlS, Co_9S_8, Co_3S_4, CoSe, GaMnAs, GaInN

and InAsN.

6. The nanoreactor as claimed in claim 1, wherein:

the shell comprises a material selected from the group consisting of Co_9S_8,

Co_3S_4, CoO, Co_3O_4, CoSe, CdS, Fe_2O_3, CdSe and Pt.

7. The nanoreactor as claimed in claim 5, wherein:

the shape of the nanoreactor is either spherical, branched, tubular or disk.

8. The nanoreactor as claimed in claim 7, wherein:

the shape of the nanoreactor is spherical, and

the outside diameter is between about 1 nm and 1000 nm.

9. The nanoreactor as claimed in claim 8, wherein:

the outside diameter is between 1 nm and 500 nm.

10. The nanoreactor as claimed in claim 9, wherein:

the outside diameter is between 5 nm and 100 nm.

11. The nanoreactor as claimed in claim 10, wherein:

the outside diameter is between 10 nm and 50 nm.

12. The nanoreactor as claimed in claim 11, wherein:

the outside diameter is between 10 nm and 30 nm.

13. The nanoreactor as claimed in claim 1, wherein:

the nanoreactor shell comprises a binary or ternary compound, wherein said binary and/or ternary compound comprises a first material and a second material, wherein:

the first material comprises a material selected from the group consisting of Pt, Zn, Co, Fe, Ti, Cd, Hg, Mg, Ga, In, Al, Ni, Sn and Bi; and

the second material is selected from the group consisting of S, Se, O, P, N, F, Cl, I, Br, As and Sb.

14. The nanoreactor as claimed in claim 13, wherein:

the diffusion rate for the first material is different than the diffusion rate for the second material.

15. The nanoreactor as claimed in claim 7, wherein:

the nanoreactor shell has a disk shape, and

the outside diameter is between about 10 nm to about 200 nm.

16. The nanoreactor as claimed in claim 15, wherein:

the outside diameter is between about 10 nm and 100 nm.

17. The nanoreactor as claimed in claim 15, wherein:

the outside diameter is between about 25 nm and 50 nm.

18. The nanoreactor as claimed in claim 7, wherein:

the nanoreactor has a tubular shape, and

the length is between about 30 nm to about 500 μm.

19. The nanoreactor as claimed in claim 18, wherein:

the length is between about 50 nm and 200 μm.

20. The nanoreactor as claimed in claim 19, wherein:

the length is between about 50 nm and 20 μm.

21. A method of making a nanoreactor, comprising

providing a nanoparticle,

coating the nanoparticle with a first material,

reacting the first material with a second material,

wherein the first and second material react to form a nanoreactor shell

encaging the nanoparticle.

22. A method of making a nanoreactor as claimed in claim 21, wherein:

the first material comprises a material chosen from the group consisting of Al, Ga, In, Tl, Sn, Pb, Bi, Po, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, La, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Li, Na, K, Rb, Cs, Be, Mg, Ca, Sr, Ba, Ge, Si, Se, Te, FeCo, CoNi and CdZn.

23. A method of making a nanoreactor as claimed in claim 21, wherein:

the second material comprises a material chosen from the group consisting of S, O, Se, Te, P, N, As, Cl, I, Br and Bi.

24. A method of making a nanoreactor as claimed in claim 23, wherein:

the second material comprises a material chosen from the group consisting of S, O, Se and Te.

25. A method of making a nanoreactor as claimed in claim 21, wherein:

the second material comprises sulfur in solution, and

the second material is combined with a solution containing the first material to make a sulfide nanoreactor.

26. A method of making a nanoreactor as claimed in claim 21, wherein:

the second material comprises O, and

a gaseous mixture containing the second material is combined with a solution containing the first material,

thereby making a oxide nanoreactor compound.

27. A method of making a nanoreactor as claimed in claim 21, wherein:

the second material comprises O, and

and the second material is in solution and is combined with a solution containing the first material,

thereby making an oxide nanoreactor compound.

28. The nanoreactor as claimed in claim 1, wherein:

the nanoparticle comprises a material selected from the group consisting of Al, Ga, In, Tl, Sn, Pb, Bi and Po, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, La, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Li, Na, K, Rb, Cs, Be, Mg, Ca, Sr, Ba, Ge, Si, Se, Te.

29. The nanoreactor as claimed in claim 28, wherein the nanoparticle comprises Pt.

30. A method of catalyzing a reaction, comprising:

contacting one or more reactants with a nanoreactor as claimed in claim 1.

31. A method of hydrodesulfurization, comprising:

contacting a compound comprising a thiophene moiety with a nanoreactor as claimed in claim 1.